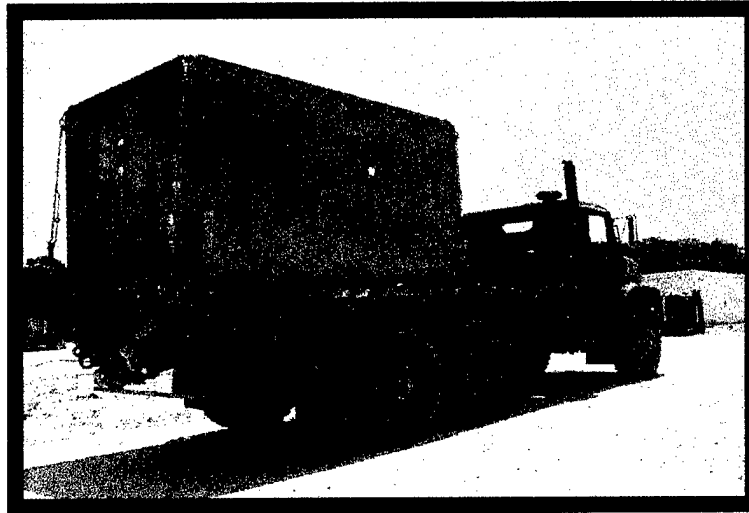


**FINAL REPORT
MARCH 2001**

REPORT NO. 00-02

**S-280 Shelter Tie-down Kit
TP-94-01, Transportability Testing Procedures**



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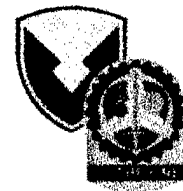
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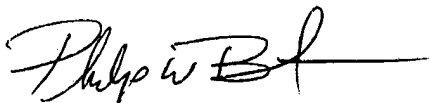
**REPORT NO. 00-02
S-280 SHELTER TIE-DOWN KIT
TP-94-01, TRANSPORTABILITY TESTING PROCEDURES**

MARCH 2001

ABSTRACT

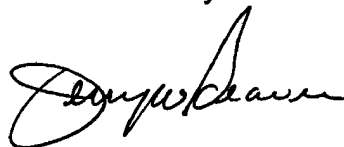
The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SMAAC-DEV), was tasked to conduct testing on the S-280 Shelter Tie-down Kit by the U.S. Army Tank-automotive and Armaments Command (TACOM). Peck and Hale Corporation of West Sayville, New York, manufactured the tie-down kit. The S-280 Shelter Tie-down Kit was tested in accordance with TP-94-01, "Transportability Testing Procedures." During testing the tie-down chain on the passenger side front disengaged from the bracket assembly. This occurred on 2 separate occasions during testing. The vibration of the shelter rings against the tie-down anchors caused the chain anchors to disengage. During testing the remaining three tie-downs remained in place and overall shelter movement was 0.5 inches. However, the possibility does exist that the other tie-downs could disengage during transport. Also, due to the close proximity of the shelter rings and the tie-down chain anchors it was difficult, or impossible, for the operator to install and remove the tie-down chains while wearing gloves. Based upon the aforementioned deficiencies, we do not recommend the Peck and Hale S-280 Shelter Tie-down Kit for shelter transport.

Prepared by:



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Reviewed by:



JERRY W. BEAVER
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MCALESTER, OK 74501-9053

REPORT NO. 00-02

S-280 SHELTER TIE-DOWN KIT
TP-94-01, Transportability Testing Procedures

TABLE OF CONTENTS

| PART | PAGE NO. |
|--|----------|
| 1. INTRODUCTION..... | 1-1 |
| A. BACKGROUND..... | 1-1 |
| B. AUTHORITY..... | 1-1 |
| C. OBJECTIVE | 1-1 |
| D. CONCLUSION | 1-1 |
| 2. ATTENDEES..... | 2-1 |
| 3. TEST EQUIPMENT..... | 3-1 |
| 4. TEST PROCEDURES | 4-1 |
| A. RAIL IMPACT TEST METHOD | 4-1 |
| B. HAZARD COURSE | 4-2 |
| C. ROAD TRIP | 4-3 |
| D. PANIC STOPS..... | 4-4 |
| E. WASHBOARD COURSE | 4-4 |
| 5. TEST RESULTS | 5-1 |
| 5.1. TRUCK, CARGO, 5 TON, 6 X 6, W/O WINCH | 5-1 |
| A. RAIL IMPACT DATA | 5-1 |
| B. HAZARD COURSE | 5-3 |
| C. ROAD TRIP | 5-3 |
| D. PANIC STOPS | 5-4 |
| E. WASHBOARD | 5-4 |
| 5.2. TRUCK, CARGO, 7-TON, W-WINCH, MK-25 | 5-5 |
| A. RAIL IMPACT DATA | 5-7 |
| B. HAZARD COURSE | 5-7 |
| C. ROAD TRIP | 5-7 |
| D. PANIC STOPS | 5-7 |
| E. WASHBOARD | 5-8 |

| | |
|--|------|
| 5.3. TRUCK, CARGO, 7-TON, W/O WINCH, MK-27 | 5-9 |
| A. RAIL IMPACT DATA | 5-9 |
| B. HAZARD COURSE | 5-11 |
| C. ROAD TRIP | 5-11 |
| D. PANIC STOPS | 5-13 |
| E. WASHBOARD | 5-13 |

PART 1 – INTRODUCTION

A. BACKGROUND. The U.S. Army Defense Ammunition Center (DAC), Validation Engineering Division (SMAAC-DEV), was tasked to conduct testing on the S-280 Shelter Tie-down Kit by the U.S. Army Tank-automotive and Armaments Command (TACOM). Peck and Hale Corporation of West Sayville, New York manufactured the tie-down kit.

B. AUTHORITY. This test was conducted IAW mission responsibilities delegated by the U.S. Army Operations Support Command (OSC), Rock Island, IL. Reference is made to the following:

1. Change 6, AR 740-1, 18 August 1976, Storage and Supply Activity Operation.

2. IOC-R, 10-23, Mission and Major Functions of USADAC, 7 January 1998.

C. OBJECTIVE. The objective of the tests was to determine if the tie-down kit would allow the S-280 Shelter to be safely secured and transported when used on the Truck, Cargo, 5-Ton, 6 x 6, w/o Winch; Truck, Cargo, 7-Ton, w/Winch; and Truck, 7-Ton, w/o Winch.

D. CONCLUSION. The S-280 Shelter Tie-down Kit was tested in accordance with TP-94-01, "Transportability Testing Procedures." During testing the tie-down chain on the passenger side front disengaged from the bracket assembly. This occurred on 2 separate occasions during testing. The vibration of the shelter rings against the tie-down anchors caused the chain anchors to disengage. During testing the remaining three tie-downs remained in place and overall shelter movement was 0.5 inches. However, the possibility does exist that the

other tie-downs could disengage during transport. Also, due to the close proximity of the shelter rings and the tie-down chain anchors it was difficult, or impossible, for the operator to install and remove the tie-down chains while wearing gloves. Based upon the aforementioned deficiencies, we do not recommend the Peck and Hale S-280 Shelter Tie-down Kit for shelter transport.

PART 2 - ATTENDEES

DATES PERFORMED: 11 April – 24 May 2000

ATTENDEE

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Peck and Hale, Inc
180 Division Avenue
P.O. Box 37
West Sayville, NY 11796

PART 3 - TEST EQUIPMENT

1. Truck, Cargo, 5-ton 6 X 6, W/o Winch

Model Number: M813 A1

Serial Number: 539762

Dimensions: Height – 116 inches

Weight – 98 inches

Length – 304 inches

Empty Weight: 20,680 pounds (as tested)

Payload: 10,000 pounds

2. Truck, Cargo, 7-ton, W/Winch

Model Number: MK-25

Serial Number: 067032

Dimensions: Height – 141.2 inches

Width – 98 inches

Length – 315 inches

Empty Weight: 28,642 pounds (as tested)

Payload: On Road – 0 – 30,000 pounds

Off Road – 0 – 14,200 pounds

3. Truck, Cargo, 7-ton, W/o Winch

Model Number: MK-27

Serial Number: 067558

Dimensions: Height – 140.7 inches

Width – 98 inches

Length – 386.5 inches

Empty Weight: 30,067 pounds (as tested)

Payload: On Road – 0 – 30,000 pounds

Off Road – 0 – 14,200 pounds

4. S-280 Shelter Tie-down Kit

Manufacturer: Peck and Hale Corporation

Weight: 840 pounds

PART 4 - TEST PROCEDURES

The test procedures outlined in this section were extracted from TP-94-01, "Transportability Testing Procedures," July 1994, for validating tactical vehicles and outloading procedures used for shipping munitions by tactical truck and railcar.

The rail impact test was conducted with the loaded vehicles secured directly to the railcar. The vehicles were secured to the railcar in accordance with MTMCTEA Pamphlet 55-19 "Tie-down Handbook for Rail Movements." The S-280 Tie-down Kit was used to secure the S-280 Shelter to the vehicle.

A. RAIL IMPACT TEST METHOD. The vehicles were loaded and secured to a conventional friction draft gear flatcar. Equipment needed to perform the test included the specimen (hammer) car, four empty railroad cars connected together to serve as the anvil, and a railroad locomotive. The anvil cars were positioned on a level section of track with air and hand brakes set and with draft gears compressed. The locomotive unit pushed the specimen car toward the anvil at a predetermined speed, then disconnected from the specimen car approximately 50 yards away from the anvil cars allowing the specimen car to roll freely along the track until it struck the anvil. This constituted an impact. Impacting was accomplished at speeds of 4, 6, and 8.1 mph in one direction and at a speed of 8.1 mph in the reverse direction. The 4 and 6 mph impact speeds were approximate; the 8.1 mph is a minimum. Impact speeds were determined by using an electronic counter to measure the time for the specimen car to traverse an 11-foot distance immediately prior to contact with the anvil cars (see Figure 1).

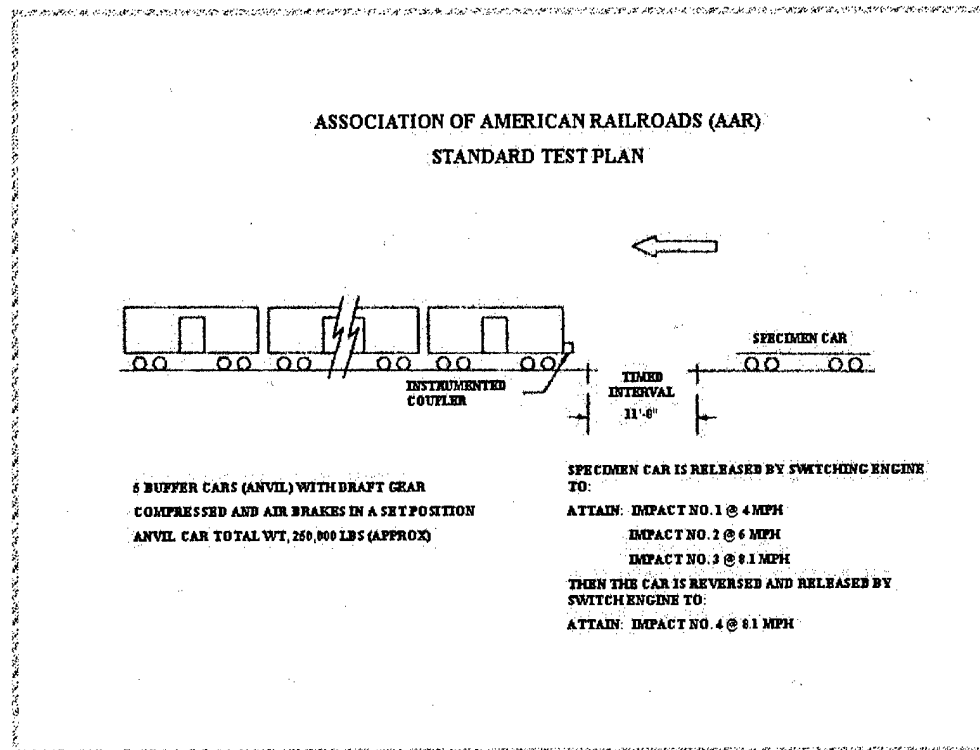


Figure 1. Rail Impact Sketch

B. HAZARD COURSE. The vehicles with the S-280 shelter and tie-down kit were transported over the 200-foot-long segment of concrete-paved road consisting of two series of railroad ties projecting 6 inches above the level of the road surface. The hazard course was traversed two times (see Figure 2) prior to the Road Trip and two times following the completion of the Road Trip.

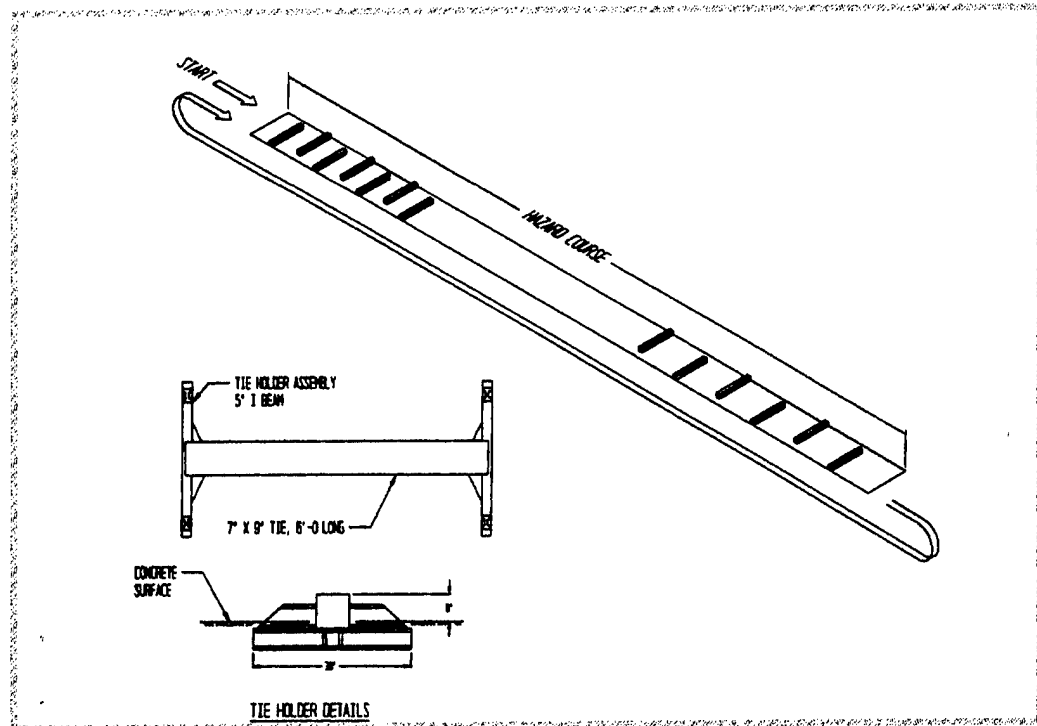


Figure 2. Hazard Course Sketch

1. The first series of ties are spaced on 8-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.
2. Following the first series of ties, a paved roadway of 75 feet separates the first and second series of railroad ties.
3. The second series of ties are spaced on 10-foot centers and alternately positioned on opposite sides of the road centerline for a distance of 50 feet.
4. The test load is driven across the hazard course at speeds that would produce the most violent vertical and side-to-side rolling reaction obtainable in traversing the hazard course (approximately 5 mph).

C. ROAD TRIP. The vehicles with the S-280 shelter and tie-down kit were transported for a distance of 30 miles over a combination of roads surfaced with gravel, concrete and asphalt. The test route included curves, corners, railroad crossings and stops and starts. The trailers traveled at the maximum speed for the particular road being traversed, except as limited by legal restrictions.

D. PANIC STOPS. The vehicles with the S-280 shelter and tie-down kit were subjected to three full airbrake stops while traveling in the forward direction and one in the reverse direction. The first three stops are at 5, 10, and 15 mph in the forward direction and approximately 5 mph in the reverse direction.

E. WASHBOARD COURSE. The vehicles with the S-280 shelter and tie-down kit were driven over the washboard course at a speed that produced the most violent response in the vehicles.

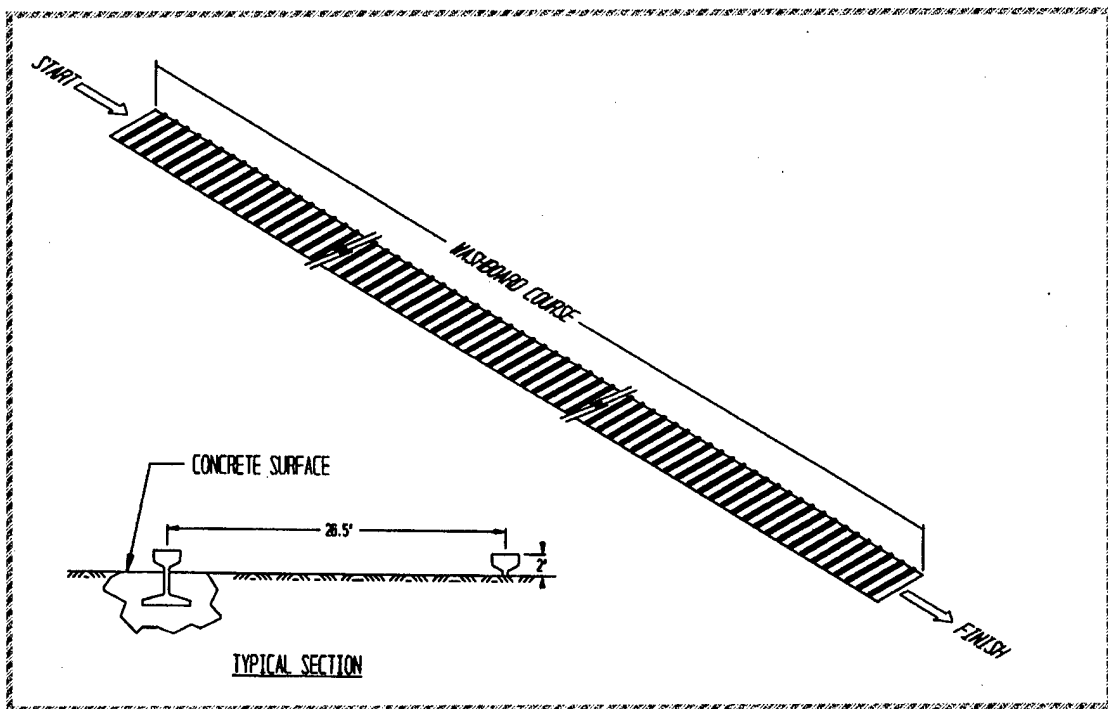


Figure 3. Washboard Course Sketch

PART 5 - TEST RESULTS

1. VEHICLE: Truck, Cargo, 5-Ton 6 X 6, w/o Winch

Payload: S-280 Shelter with S-280 Tie-down Kit

Payload Weight: 7,340 pounds (S-280 Shelter weight – 6,500 pounds,
S-280 Tie-down Kit weight - 840 pounds)

Date: 11 April 2000

A. RAIL IMPACT DATA



Rail impact test of S-280 Shelter with Tie-down Kit

| DESCRIPTION | WEIGHT |
|-------------------------------|--------------|
| Flatcar Number: HTTX 92931 | 67,800 lbs. |
| 5-Ton Truck | 20,680 lbs. |
| S-280 Shelter | 6,500 lbs. |
| S-280 Shelter Tie-down Kit | 840 lbs. |
| Total Specimen Wt. | 95,820 lbs. |
| Buffer Car (four cars) | 250,000 lbs. |

| Impact Number | Velocity (mph) | Remarks |
|---------------|----------------|---------|
| 1 | 3.9 | None |
| 2 | 6.3 | None |
| 3 | 8.3 | None |
| 4 | 8.2 | None |

Remarks: No damage or failures occurred with the S-280 Shelter, S-280 Shelter Tie-down Kit or the vehicle.

B. HAZARD COURSE



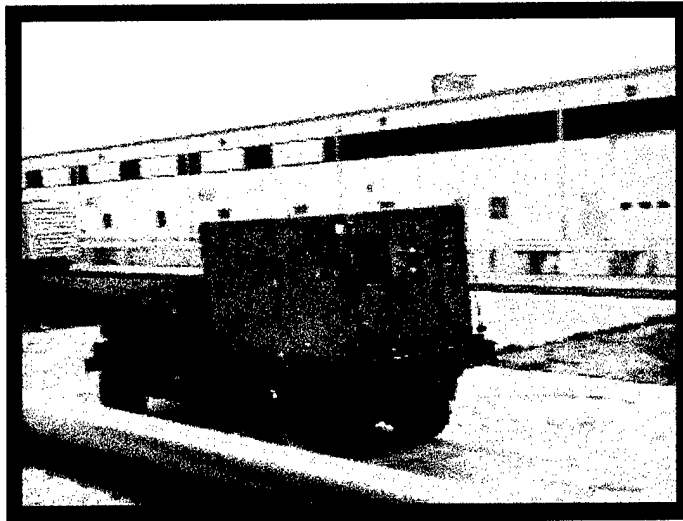
Hazard course test of S-280 Shelter with Tie-down Kit

| PASS NO. | ELAPSED TIME | VELOCITY (MPH) |
|----------|--------------|----------------|
| 1 | 32 Seconds | 4.3 |
| 2 | 32 Seconds | 4.3 |
| 3 | 40 Seconds | 3.4 |
| 4 | 35 Seconds | 3.9 |

Remarks: The tie-down anchor on the front passenger side came out during transport over the road course. The vibration of the shelter rings against the tie-down anchors caused the chain anchors to disengage. The overall shelter movement was 0.5 inches toward the passenger side of the vehicle. The remaining three tie-downs did not disengage during testing. The tie-down was reattached and testing continued.

C. ROAD TRIP: No damage or failures occurred with the S-280 Shelter, S-280 Shelter Tie-down Kit or the vehicle.

D. PANIC STOPS: No damage or failures occurred with the S-280 Shelter, S-280 Shelter Tie-down Kit or the vehicle.



Panic stop with S-280 Shelter and Tie-down Kit

E. WASHBOARD: No damage or failures occurred with the S-280 Shelter, S-280 Shelter Tie-down Kit or the vehicle.



Washboard course test with S-280 Shelter and Tie-down Kit

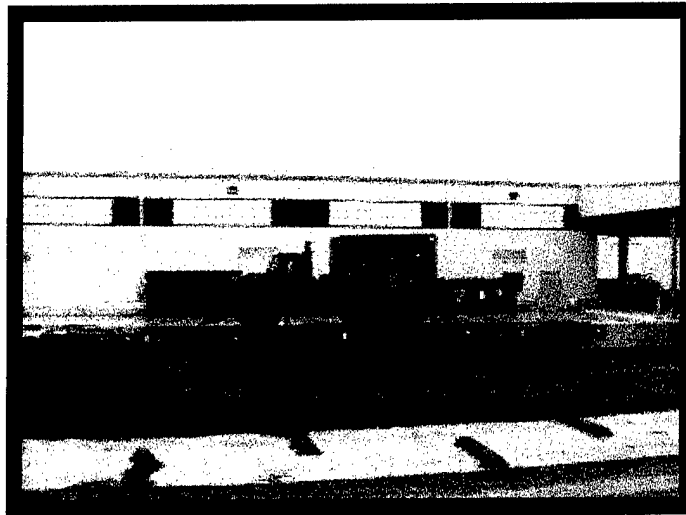
2. VEHICLE: Truck, Cargo, 7-Ton, w/Winch (MK-25)

Payload: S-280 Shelter with S-280 Tie-down Kit

Payload Weight: 7,340 pounds (S-280 Shelter weight – 6,500 pounds,
S-280 Tie-down Kit weight - 840 pounds)

Date: 12 April 2000

A. RAIL IMPACT DATA



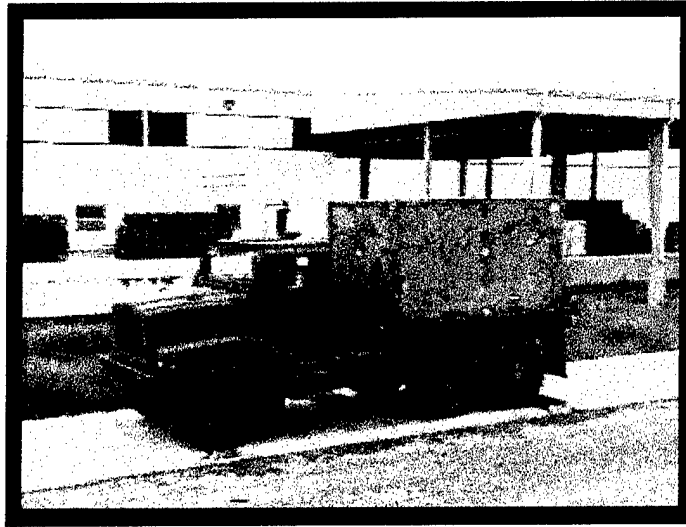
Rail impact testing of S-280 Shelter with Tie-down Kit

| DESCRIPTION | WEIGHT |
|-------------------------------|--------------|
| Flatcar Number: HTTX 92931 | 67,800 lbs. |
| MK 25 (empty) | 27,480 lbs. |
| S-280 Shelter | 6,500 lbs. |
| S-280 Shelter Tie-down Kit | 840 lbs. |
| Total Specimen Wt. | 102,620 lbs. |
| Buffer Car (four cars) | 250,000 lbs. |

| Impact Number | Velocity (mph) | Remarks |
|---------------|----------------|---------|
| 1 | 3.9 | None |
| 2 | 6.3 | None |
| 3 | 8.3 | None |
| 4 | 8.2 | None |

Remarks: No damage or failures occurred with the S-280 Shelter, S-280 Shelter Tie-down Kit or the vehicle.

B. HAZARD COURSE



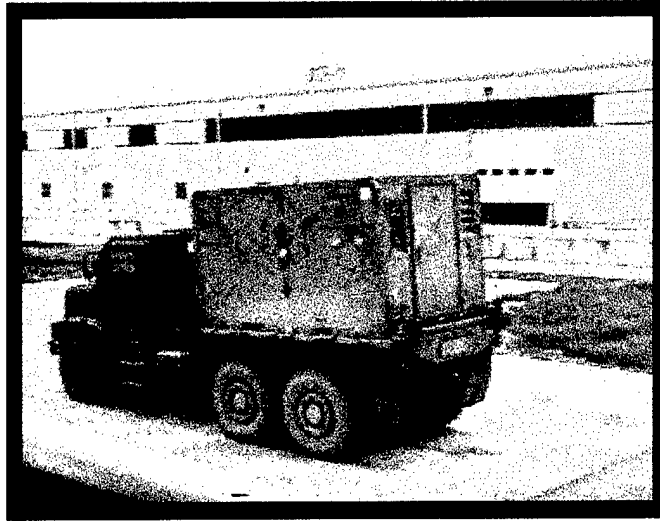
Hazard course testing of S-280 Shelter with Tie-down Kit

| PASS NO. | ELAPSED TIME | VELOCITY (MPH) |
|----------|--------------|----------------|
| 1 | 28 Seconds | 4.9 |
| 2 | 28 Seconds | 4.9 |
| 3 | 27 Seconds | 5.1 |
| 4 | 25 Seconds | 5.5 |

Remarks: No damage or failures occurred with the S-280 Shelter, S-280 Shelter Tie-down Kit or the vehicle.

C. ROAD TRIP: No damage or failures occurred with the S-280 Shelter, S-280 Shelter Tie-down Kit or the vehicle.

D. PANIC STOPS: No damage or failures occurred with the S-280 Shelter, S-280 Shelter Tie-down Kit or the vehicle.



Panic stop testing of S-280 Shelter with Tie-down Kit

E. WASHBOARD: No damage or failures occurred with the S-280 Shelter, S-280 Shelter Tie-down Kit or the vehicle.



Washboard course testing of S-280 Shelter with Tie-down Kit

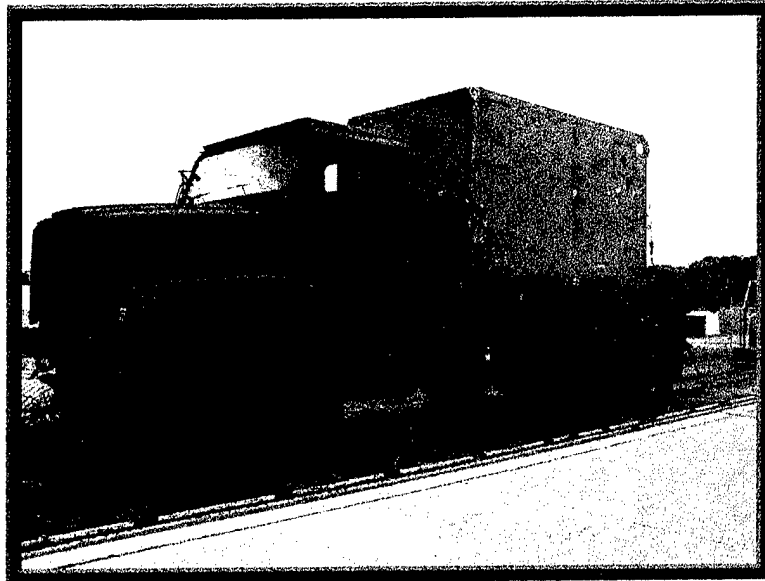
3. VEHICLE: Truck, Cargo, 7-Ton, w/o-Winch (MK-27)

Payload: S-280 Shelter with S-280 Tie-down Kit

Payload Weight: 7,340 pounds (S-280 Shelter weight – 6,500 pounds,
S-280 Tie-down Kit weight - 840 pounds)

Date: 11 –25 May 2001

A. RAIL IMPACT DATA



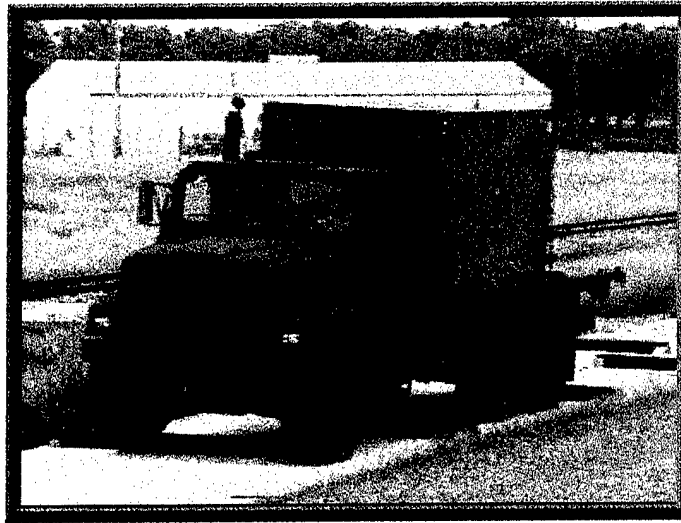
Rail impact testing of S-280 Shelter with Tie-down Kit

| DESCRIPTION | WEIGHT |
|-------------------------------|--------------|
| Flatcar Number: HTTX 92931 | 67,800 lbs. |
| MK 27 (empty) | 27,480 lbs. |
| S-280 Shelter | 6,500 lbs. |
| S-280 Shelter Tie-down Kit | 840 lbs. |
| Total Specimen Wt. | 102,620 lbs. |
| Buffer Car (four cars) | 250,000 lbs. |

| Impact Number | Velocity (mph) | Remarks |
|---------------|----------------|---------|
| 1 | 4.5 | None |
| 2 | 6.1 | None |
| 3 | 8.6 | None |
| 4 | 8.5 | None |

Remarks: No damage or failures occurred with the S-280 Shelter, S-280 Shelter Tie-down Kit or the vehicle.

B. HAZARD COURSE



Hazard course testing of S-280 Shelter with Tie-down Kit

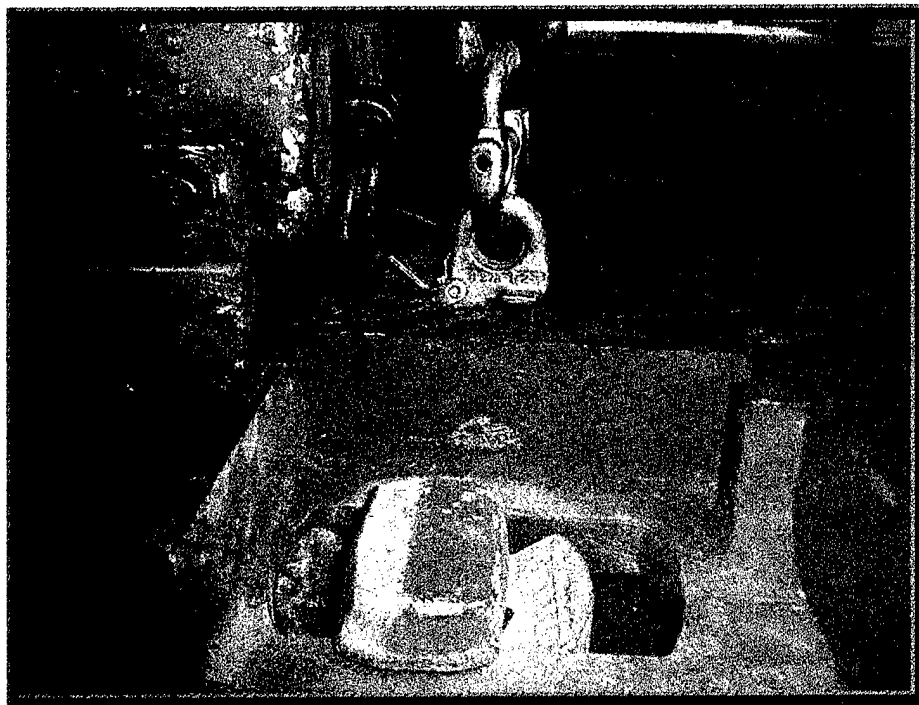
| PASS NO. | ELAPSED TIME | VELOCITY (MPH) |
|----------|--------------|----------------|
| 1 | 29 Seconds | 4.7 |
| 2 | 26 Seconds | 5.2 |
| 3 | 24 Seconds | 5.7 |
| 4 | 24 Seconds | 5.7 |

Remarks: Following completion of Pass #2 on 11 May 2000 the turbocharger on the vehicle failed. Testing was stopped and the vehicle was repaired. The shelter and kit were removed from the vehicle during the repair. Testing resumed on 24 May 2000.

C. ROAD TRIP: The tie-down anchor on the front passenger side came out during transport over the road course. The vibration of the shelter rings against the tie-down anchors caused the chain anchors to disengage. The overall

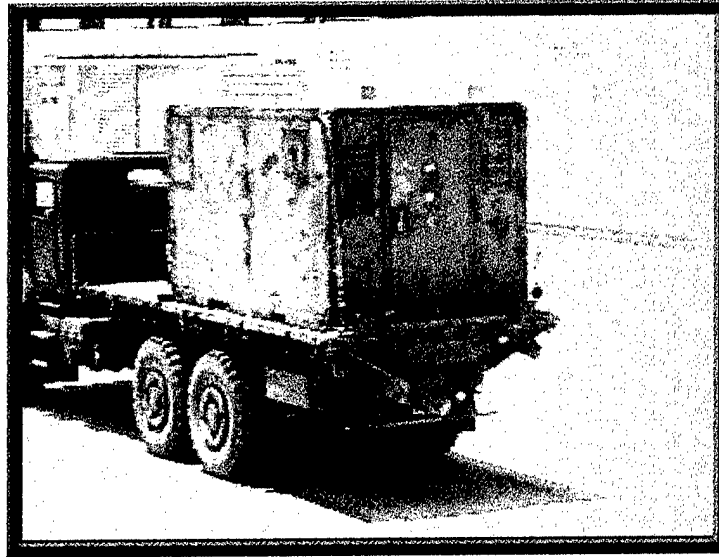
shelter movement was 0.5 inches toward the passenger side of the vehicle. The remaining three tie-downs did not disengage during testing. The tie-down was reattached and testing continued.

Also, due to the close proximity of the shelter rings and the tie-down chain anchors it was difficult, or impossible, for the operator to install and remove the tie-down chains while wearing gloves. (see photo)



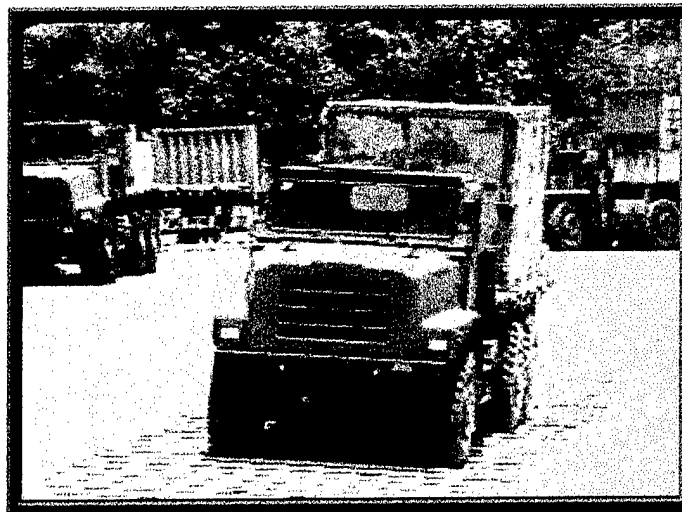
Location of Shelter rings to the chain anchors

D. PANIC STOPS: No damage or failures occurred with the S-280 Shelter, S-280 Shelter Tie-down Kit or the vehicle.



Panic stop testing of S-280 Shelter with Tie-down Kit

E. WASHBOARD: No damage or failures occurred with the S-280 Shelter, S-280 Shelter Tie-down Kit or the vehicle.



Washboard course testing of S-280 Shelter with Tie-down Kit